11

PATERNITY ACTIONS—A MATTER OF OPINION OR A TRIAL OF THE BLOOD?

Most probably since time immemorial, unmarried women have charged that particular men were fathers of their children. These accusations are easily made and frequently denied, but at least in past centuries and the earlier part of this century, not so easily proved or disproved on a scientific basis. Indeed, many known injustices have occurred, the most notorious example having been the case involving Charlie Chaplin in California a few decades ago.

At the present time, advancements in the field of immunohematology permit sophisticated analyses to be performed that in a large percentage of cases can scientifically exclude falsely accused men. While it is not as yet possible to unequivocally determine whether or not a particular man is the father of a specific child, in many instances it is possible to raise a strong scientific suspicion along those lines, based upon various immunologic features found in the blood of the baby and the putative father.

The evolution of paternity actions is a fascinating experience to study and tells a great deal about criminal justice processes in the United States. Such a review also gives extensive details about the marvelous technologic advancements that have occurrred in the past few decades and demonstrates how skilled professional people, given adequate blood samples of the mother, baby and putative father, can come up with meaningful results that in many instances can be conclusive.

Attorney Michael Beautyman has done an excellent job in studying the history of paternity actions and depicting the advancements that have occurred in such cases throughout the past several years. Mr. Beautyman's chapter will be of great value to all forensic pathologists, medicolegal investigators and trial attorneys who from time to time become involved in the prosecution or defense of paternity actions. Full knowledge and understanding of Mr. Beautyman's presentation will go a long way in permitting all professionals to more adequately and effectively pursue their respective roles in the scientific evaluation and the legal presentation of paternity cases.

PATERNITY ACTIONS—A MATTER OF OPINION OR A TRIAL OF THE BLOOD?

MICHAEL J. BEAUTYMAN

INTRODUCTION

"A trial of bastardy is a trial of the blood."[1]

The bastardy or paternity action, a centuries-old[2] judicial means of ascertaining paternity, has become widespread in American courts in the past two decades.[3] The action may be brought by the mother or father[4] or, in many jurisdictions, by public welfare authorities,[5] any charitable organization with an interest in the matter,[6] any person having legal custody of the child,[7] or even simply any interested person.[8] Paternity may be an issue in a variety of settings: a support proceeding, where the mother seeks financial aid from the putative father,[9] a divorce proceeding where the ground is adultery,[10] or an annulment proceeding, where either husband or wife may try to prove premarital conception by someone other than the husband;[11] or filiation may be the only issue as where a natural father[12] or a child[13] wishes to prove paternity for financial[14] or familial reasons.

Such actions are, because of their subject matter, a great strain on the parties,[15] a painful and often sordid forensic proceeding where the truth, concealed by accusation and counteraccusation, cannot easily be determined by a judge and jury compelled by the drama and by human nature to use subjective criteria.[16] Whatever the factual source of the case, the truth is elusive because the evidence is always circumstantial and the temptation to lie is great,[17] lending credence to charges that paternity suits provide fertile ground for legal "shakedowns."[18] One study based on blood tests indicates that in a group of 1,000 cases of disputed paternity, at least 39.6 percent of the accused men were not

Copyright © 1974 by Michael J. Beautyman.

actually the fathers of the children in question.[19] On the basis of a six-year study of 312 paternity cases, lie detector experts concluded that "93 percent of the tested parties lied in some respect when they testified in court as to their sexual relationship."[20] Of 361 plaintiffs in an Orange County, California study, 142 lied on the critical question of whether they had sexual relations with other men during the conception period.[21] Conviction rates reaching 95 percent are not uncommon in paternity actions.[22] Harry D. Krause, former chairman of the American Bar Association's Subcommittee on Paternity, summarizes:

> Current paternity prosecution practice in many metropolitan areas is abhorrent. Blackmail and perjury flourish, accusation is often tantamount to conviction, decades of support obligation are decided upon in minutes of court time and indigent defendants usually go without counsel or a clear understanding of what is involved.[23]

Since a paternity suit by its nature is commonly decided on highly suspect proof, the law should strive for objective means to ascertain the truth. Genetic tests, which either prove nonpaternity (by exclusion of the putative father) or establish the probability of paternity, provide a solution because the laboratory, in contrast to the courtroom, is objective. But the law has not readily embraced this solution. Those jurisdictions which presently accept genetic tests in paternity proceedings accept only one type of test, the blood grouping or immunohematologic test,[24] according it varying degrees of weight, to establish nonpaternity.[25] No final decision in any case has been based on test results which failed to exclude the possibility of paternity.[26] Test results showing a likelihood of paternity have not been admitted into evidence.

In the light of advances in the field of human genetics, there is no reason for the law's remarkable reluctance to admit genetic evidence when paternity is in issue. The law of affiliation should capitalize on advancements in the practical applications of human genetics which could alleviate much of the anguish of paternity suits, reduce caseloads, and vastly increase the chances of reaching an accurate finding of paternity. It is the thesis of this article that appropriate tests, conducted by experts, establishing the likelihood of paternity should be compulsory[27] in all disputed affiliation cases. As will be shown later, this likelihood may be expressed as a mathematical probability. Where the probability is zero (ie, where paternity is excluded), this evidence should be accepted as conclusive. If the probability is greater than zero, this probability should be weighed in evidence by the judge and jury. If the probability of paternity is sufficiently high, as it will be in almost all cases of nonexclusion where an extensive series of genetic tests is used, this probability should be considered conclusive of an affirmative assignment of paternity.

OUTLINE OF SCIENTIFIC PROCEDURES IN HUMAN GENETICS APPLICABLE TO PATERNITY TESTING[28]

The cells of the body consist of a nucleus surrounded by cytoplasm. All of these cells are derived by repeated division from the original single cell, the zygote, formed by the fusion of a spermatozoon with an ovum. The genetic material that is handed on from generation to generation according to the laws of inheritance is contained in the cell nucleus. When a cell divides, the nuclear material arranges itself into 23 pairs of threadlike structures called chromosomes. One of each of the pairs of chromosomes is inherited from the father and the other is inherited from the mother, thereby providing the key to establishing paternity.[29]

Normally the chromosomes in each pair are identical, except for the pair of sex chromosomes in the male.[30] But the 22 pairs of non-sex chromosomes, called autosomes, may be distinguished, one pair from another, by slight gradations in size and appearance. More noticeable differences are demonstrated when the chromosomes are immersed in suitable stains. Usually the chromosomes within a pair are similar even when stained,[31] but occasionally a single chromosome in a pair will show some unusual marking. Since the chromosome is inherited, the unusual marking allows it to be traced to one of the parents. This is particularly true of the Y chromosome which not infrequently shows some distinguishing characteristic that, if rare in the population at large but present in both the child and the putative father, could be used as evidence of paternity.[32]

Each chromosome carries many genes and each gene, occupying a fixed position on the chromosome known as a locus, is responsible for the synthesis of a protein or part of a protein. Since the chromosomes are similar in 22 of the pairs, each gene is represented twice. However, since the genes at the same locus on the paired chromosomes may not be absolutely identical, the genes may be responsible for synthesizing slightly different variants of a particular protein. Such variant genes at the same locus are known as allelomorphs (alternative forms), and the resulting phenomenon of individuals with proteins of slightly different structures is known as polymorphism.[33] It is this phenomenon of polymorphism that is responsible for most of the scientific evidence that can be amassed for or against paternity in a particular situation.

The total number of genes in an individual is known as the genotype, and the total complex of characteristics as determined by the genes that can be detected in the individual is known as the phenotype.[34] However, both these terms are often used in a more restricted sense. For example, one may speak of the genotype and the phenotype with reference to one small group of genes and their resulting characteristics, as in the ABO blood group system.

Because the chromosomes and the genes they carry are faithfully copied from generation to generation, the differences in body proteins are subject to the laws of inheritance and may be detected by a variety of techniques.[35] In a typical paternity suit it would not be necessary to use all available techniques because use of only a few may yield either an exclusion or a probability of paternity sufficiently high to merit consideration by the court.

Moreover, with only a few techniques, the population can be divided into an enormous number of phenotypes. For example Sussman[36] has shown that by considering blood groups only (and not a complete list of these), the population could be divided into approximately 58 million phenotypes. If these blood group phenotypes are added to the 4,477 phenotypes of the HL-A system,[37] then approximately 260 billion possible phenotypes are obtained. If all the other polymorphisms are included, the final figure would, of course, be far greater. This does not mean that all these phenotypes exist and there may be more than one person with the same phenotype, but the figures quoted give an idea of the power of this method of determining individuality.

How these various techniques can be used to determine paternity may be illustrated by blood group tests. Given the genotypes of a child and his mother, a scientist can state positively that men of certain blood types could not be the father. There are two classes of exclusion: (1) a man is excluded if he and the mother both lack a gene which the child has, because a child cannot have a gene lacked by both parents;[38] for example, an O father and an A mother cannot have a B child because neither putative parent has the B gene; (2) a man is excluded if genes which he must hand on are not present in the child; for example, an AB man cannot have an O child because an AB parent must contribute either an A or a B gene to the child.

The more genetic systems tested, the greater is the chance of detecting a false accusation of paternity. For example, the chance of exclusion on the basis of the ABO system alone is about 17.6 percent. The MNS[39] system raises the chance to 37.29 percent, and further testing by the Rh system increases the chance for exclusion to 53.09 percent.[40] By testing a number of HL-A systems, the chances are raised to approximately 98.5 percent.[41] Thus, if thorough testing does not foreclose the issue by proving an exclusion, the tests will already have established a high mathematic probability of paternity because the more procedures carried out that do not provide an exclusion, the greater the probability that the putative father is the true father.

By examining appropriate material (nearly always blood) from the mother and the child, it is possible to determine which phenotypic characters the child must have inherited from its father. Since the mother does not have all this scientific data at the time she accuses the man, the fact that this detailed description fits the father and fits very few other men in the population at large is of great significance. The child in effect gives a detailed description of its father, thereby reducing perjury and almost eliminating error.[42] Furthermore, this is a description that can be checked and rechecked by different experts in the field as often as desired.

Progress in genetic research has made it possible to conduct more extensive paternity tests, raising not only the likelihood of exclusion but also the likelihood of a positive assignment of paternity.[43] Affirmative proof of paternity through the aforementioned techniques is based on mathematic probability.[44] The chance the putative father has of passing on the genes which must be of paternal origin (because lacking in the mother) is compared with the chance of obtaining such genes from a man in the random population because if the putative father is not the true father, he is a randomly selected man from the blood group point of view. For example, if a child has a gene X that must have been received from the father and if this gene is present in the putative father but is present in, say, only one in fifty of the general population, this is evidence that should be weighed by the court. Each genetic factor considered from the variety of techniques available, beyond simple blood grouping, narrows further the number of potential fathers.

By employing several techniques, one can most likely reach a level of probability sufficiently high to merit a positive assignment of paternity.

The key to such assignment is that the probability of paternity based on each genotype can be given precise mathematic expression because that genotype occurs with a known frequency. If the putative father is homozygous[45] for a particular gene, his chance of passing that gene on to offspring is 100 percent; if heterozygous,[46] 50 percent. His chance of passing on all the found characteristics is computed by multiplying the individual chances together. The chance of obtaining such a set of genes from the random male population is computed by multiplication of the frequencies in the population of each of the relevant genes. Comparison of the two chances yields a percent probability of paternity. Various mathematic approaches have been used but they give essentially similar results.[47] The most common method in use is Essen-Möller's adaptation of Bayes' theorem[48] that has had wide use, paricularly in West Germany.

Eleven years ago the growing body of data on heritable characteristics useful for paternity proceedings led one prominent researcher to conclude:

> The data at the disposal of the physical anthropologist contain sufficient information to determine in 19 out of 20 cases, at a level of three sigma significance (99.73 plus probability), whether a given individual is the parent of a child in question.[49]

An illustration of how such a high level of probability is possible is shown by the Essen-Möller formula. If one identifies 10 genes which must be in the true father and the frequency of each gene in the general population happens to be 0.5, then the probability that a putative father with those 10 genes is the true father is 94.67 percent. The more genes identified as necessarily in the true father, the higher the probability that a putative father with those genes is the true father. For example, if one identifies 20 genes which must be in the true father and the frequency of each gene in the general population happens to be 0.5, then the probability that a putative father with those 20 genes is the true father is 99.68 percent. For 100 so identified genes, the probability becomes 99.999999999967 percent. Note that this is not proof of exclusion but an affirmative showing of paternity! Given the vast number of phenotypes presently known, it is not impossible that 100 genes could be so identified in a particular paternity suit.[50]

Pitfalls

No human endeavor is foolproof, and, in the case of blood tests, the error has been variously estimated as one in 10,000 to one in 50,000. The miniscule chance of error does not mean that these tests may be performed by any laboratory,[51] because sources of error are legion:[52] administrative mistakes such as mislabelling of specimens, improper identification of parties, technical errors such as failure to see the agglutination reaction, improper control of temperature, serum concentration, or time of reaction; mechanical blunders such as failing to add serum to one of forty test tubes or adding antiserum twice to one tube. Biologic quirks such as the rare Bombay groups may cause confusion because it may appear that a group O man has passed on an A gene. However, these rare groups are readily detected by proper testing.[53] Finally, mutations have been estimated to occur at the rate of 1 in 1,000,000,[54] but leading blood group specialists are beginning to doubt whether a blood group gene mutation has yet been demonstrated.[55]

The fact that specialized serologic and genetic knowledge and expertise are required does not mean that the necessary services are beyond the reach of most parties. It is a common practice to ship blood specimens to laboratories by air freight.[56] The present cost for an extensive range of blood tests is approximately $400.00, which is usually borne by the party requesting the tests.[57] Use of the additional testing techniques described in this article should not add appreciably to this figure, provided that the tests are performed at regional centers doing volume work. For a putative father faced with a potential 18 years of child support ($46,800 for a support judgment of $50 per week), such expense seems negligible.

Paradoxically, the possibility of error, although small, may explain in part the hesitation of the courts to accept even blood group test results. A judge often believes, rightly or wrongly, that he can measure the credibility of witnesses by observing their demeanor, and he may develop a strong conviction as to the true story behind the testimony. Even though the judge realizes that theoretically there are many sources of error in the formulation of his convictions, he may feel more certain in attaching weight to considered testimony than to blood test evidence where the average chance of error has been given a numeric value.[58] Yet the advantage of using the results of genetic analysis in paternity suits is that such evidence *is* precise. The identification procedures used in many areas of the law are vague. Paternity is presently determined by the court on extraordinarily flimsy evidence for which there is no quantitative measure of value.[59] The law should not ignore genetic evidence which can provide a precise and objective basis for deciding such an important question as the paternity of a child.

WEIGHT AND SUFFICIENCY OF BLOOD TESTING RESULTS: THE PRESENT STATE OF THE LAW

A survey of current law reveals legislative and judicial reluctance to place evidentiary value even in the commonly used blood group tests. At the present time only eight state statues will admit blood test results showing the possibility of paternity.[60] What is more surprising is that blood group proof that the accused man could not have been the actual father, while generally accepted into evidence,[61] is still not considered conclusive proof by some jurisdictions[62] but is merely an item of evidence to be weighed with other evidence.

The Uniform Act on Blood Tests to Determine Paternity, approved by the National Conference of Commissioners on Uniform State Laws and the American Bar Association in 1952, has been adopted by only nine states[63] and one territory.[64] The Uniform Act provides that on motion of a party or on motion of the court blood tests may be ordered to be performed on the mother, child and putative father.[65] In those states where there is no statute specifically providing for blood tests, courts have generally assumed the power to order the tests.[66] The tests may be performed under the Uniform Act by experts selected by the court and by any party who is to be tested. When the experts agree on the accuracy of the tests, the results are conclusive on the issue of nonpaternity.[67] The Act also provides that if the experts conclude the blood tests show the possibility of the alleged father's paternity, admission of this evidence is within the discretion of the court,[68] depending upon the infrequency of the blood type. Of the nine states enacting the Uniform Act, four excised the last mentioned provision.[69]

It is submitted that both the current practice with respect to blood typing evidence in the majority of states and the Uniform Act on Blood Tests to Determine Paternity are out of date. Neither takes full advantage of modern scientific techniques to alleviate much of the anguish of paternity suits, reduce case loads, and increase the chance of reaching a truthful determination of paternity. Blood test evidence should be considered conclusive if it proves nonpaternity; an expert determination of the exact probability of paternity should be admissible and weighed with other evidence; blood tests on mother, child, and putative father should be compulsory in all paternity actions.

THE ARGUMENTS AGAINST THE SCIENTIFIC APPROACH

There are three principle reasons why American courts have been hesitant to consider genetic evidence to establish paternity and even nonpaternity: (1) reluctance to rely totally on laboratory tests for a judicial determination, (2) reluctance to base a decision on a probability when defined numerically, and (3) reluctance to cast aside the presumption of legitimacy of the child of a married mother.

The first objection is invalid because properly performed blood tests are accurate[70] and may be checked entirely, if desired, in one or more additional expert laboratories. The same accuracy cannot be ascribed to the other evidence which will be circumstantial and probably distorted.[71] A court is not surrendering its jurisdiction to the laboratory but merely taking advantage of the best available help in dispensing justice.

Judicial reluctance to deal in medical probabilities explains the universal American rule by which courts will accept only proof of nonpaternity,[72] but this reluctance is unjustified. Exclusions can be established with scientific certainty, and inclusions can be established by degrees of probability. Where the same rare genes are found in both putative father and child, "the possibility of coincidence being responsible is so remote as to make the odds astronomical."[73] In less extreme situations, the probability of paternity can be computed quite precisely[74] and submitted as evidence to the jury.

Although the law courts would like to deal solely with factual certainty, they must settle as a practical matter for a level of probability only slightly better than 50-50. In civil cases, including paternity suits, facts are determined and decisions reached on the basis of a preponderance of the evidence.[75] In emotion-charged paternity litigation, where perjury is not uncommon,[76] the jury may decide legitimacy, divorce, child support, or other substantial civil questions on whether, for example, access of a given man to a woman was proved only slightly more convincingly than lack of access.

Thus, even if scientific tests cannot verify paternity with absolute certainty the positive proof may reach a level of probability which is entirely acceptable in legal terms. It would justifiably be considered conclusive in cases involving rarer genes. The weight to be given the fact that an exclusion was not established by the tests should be computed in terms of statistical probabilities by an expert. That is, if the constellation of mother, child, and putative father is such that only a small percentage of the male population would not be excluded as possible fathers, then this fact should be weighed along with the other evidence. Other relevant biologic evidence includes the male's capacity of procreation with the woman concerned, the time when coitus took place relative to the probable time of conception and the relation of sexual intercourse to the woman's menstrual cycle. This evidence will be complemented by the court's impression of the veracity of the parties' testimony. The sum of the former is more reliable than the latter, yet at the present time every American court chooses to ignore the precisely determinable probability of paternity and essentially bases its decision on demeanor evidence.

One authority on paternity suits, Sidney B. Schatkin, argues against accepting such evidence on the ground that the accused man will no longer demand a blood test for fear of weakening his defense.[77] However, as Schatkin himself has noted, "the courts have continued to give controlling weight to the uncorroborated testimony of the (mother) and little credence to the (accused man)."[78] In every state the burden of disproof is on the accused man.[79] Without a blood test, the putative father's case is so weak as to encourage tests on the chance of proving exclusion.[80]

Another argument against allowing blood test evidence of paternity is that the jury might be misled.[81] On the contrary, what is likely to mislead the jury is the conflicting circumstantial evidence of witnesses who, as a class, have shown a remarkable propensity to perjure themselves.[82] In any case, we rely on juries in other factual settings for the resolution of highly complex issues. A jury is more likely to grasp testimony on the meaning of a 95 percent chance of paternity than many of the intricate facts arising in, for example, a medical malpractice action.

Medical knowledge is now sufficiently developed to permit courts to introduce evidence tending to prove paternity as well as nonpaternity.[83] European[84] and Canadian[85] courts, where blood tests were commonplace long before they found acceptance in the United States, have shown far greater willingness to accept medical progress.[86] In some European countries blood group analysis has been routinely carried out for many years in all cases in which paternity is denied.[87] In West Germany, for example, a law passed in 1970 states that an 80 percent probability of paternity determined from blood tests requires a finding of paternity. A 50 to 80 percent probability means that additional anthropologic findings are required. Where the anthropologist concludes that paternity is "very unlikely" or "practically excluded," the case is dismissed.

Another obstacle to the admission of genetic evidence is the presumption that a child born in wedlock is legitimate. The presumption is still recognized in every jurisdiction, but its strength varies considerably. Most courts have taken judicial notice of scientific advances and consider the presumption rebuttable by blood test evidence excluding the putative father.[88] However, several jurisdictions still consider the presumption conclusive, so blood test evidence showing the husband could not have been the father will not overcome the presumption.[89]

The presumption of legitimacy, known as the Lord Mansfield Rule, developed in the nineteenth century when its' namesake ruled[90] that the spouse to whom a child was born could not testify to any facts indicating illegitimacy until it was shown that one spouse had no access to the other during the period in which conception must have taken place. After the nonaccess was proven, the spouses could testify, but their testimony could not relate to the facts of nonaccess.[91]

Courts have clung to the presumption on the basis of such social values as preservation of the integrity of the family, protection of the innocent child from the social stigma of illegitimacy, and desire to have an individual rather than the state assume the financial burden of supporting the child.[92] Today, in the face of nearly infallible blood test evidence, these reasons are no longer persuasive, particularly if the tests show a biologic exclusion of the husband.

The first argument can be met by noting that there is little family integrity to be preserved by the time husband and wife are battling in court over the legitimacy of a child. Where a husband has denied being the father of his wife's child, but has been unable because of the strength of the presumption of legitimacy to prove that he is not, the emotional and financial effect on the child is not likely to be beneficial if the husband is nevertheless still firmly convinced that he is not the father. The ready availability of blood tests can serve to quiet one way or the other an already suspicious husband and will do so without the rancor of courtroom battles fraught with circumstantial evidence of adulterous relationships.

Some courts have held that the only reason for excluding blood test evidence is the public policy of not allowing a parent to bastardize a child for the "parents' " profit.[93] Reluctance to label a child illegitimate would be well-founded if the courts were not already declaring children illegitimate on less reliable evidence. By failing to make full use of scientific evidence the courts are striking an inconsistent position. They will bastardize some children, and will do so on imprecise evidence, but they will not resort to techniques which give illegitimacy, as a legal classification, a biologic definition.

At common law illegitimate children were the unfortunate members of society upon whom the sins of the fathers were visited a hundredfold. They had no right to inherit, nor could they be rendered legitimate by any subsequent act of their parents. Today, treatment distinguishing legitimate and illegitimate children has been remedied in many areas by statute[94] or judicial decree.[95] Now that the stigma of illegitimacy is no longer as disgraceful or indelible, the risk of injustice to the husband should be more evenly balanced against that to the child. It is illogical to structure presumptive rules around the biased treatment of illegitimate children. The biased treatment should be changed rather than compounding the problem by requiring some husbands to support a child they believe to be fathered by another.

The policy of requiring an individual rather than the state to provide for the child has weakened in recent years as welfare statutes have proliferated. The policy against state support is also less than compelling because it does not explain why biologic paternity is ignored only in the narrow class of cases that involve the conclusive presumption that a child born in wedlock is legitimate as opposed to the rebuttable presumption. To single out certain husbands for the burden of supporting, emotionally and financially, another's child on the basis of such a diminished policy is unequal treatment without a rational foundation. If there is an overriding social interest, it must be that paternity be established accurately with a minimum of courtroom trauma. As a High Court judge said in a well-known English case where a blood test proved adultery:

> There is nothing more shocking than that injustice should be done on the basis of a legal presumption when justice can be done on the basis of fact . . .[96]

The present statutory and judicial rules regarding blood test results as evidence in resolving paternity have become constitutionally unsound in light of advancements in the science of human genetics. Where tests can establish with near perfect accuracy the likelihood that a person is or is not the father of the child in question, fundamental fairness[97] would require the use of these tests.[98]

Given the undependable circumstantial evidence in paternity suits in contrast to the objectivity of the laboratory, it is reasonable to give the courts discretion to make blood tests compulsory for all parties. The Uniform Act on Blood Tests to Determine Paternity provides that, on failure to comply with a court-ordered blood test, the court may either enforce its order or resolve the question of paternity against the recalcitrant party.[99] Some states make it mandatory upon any court to grant a defendant's motion for a blood test.[100] The permissive rule of the Uniform Act is preferable because it allows courts to deny a motion for blood tests on religious grounds.

Moreover, a compulsory rule would prevent abuses of the judicial process[101] without infringing any of the parties' rights. It has been held that a court may order parties to submit to a blood test without infringing constitutional guarantees[102] against self-incrimination,[103] unlawful search and seizure,[104] or precipitating a violation of due process,[105] or the right of privacy.[106]

CONCLUSION

The legal profession should recognize the great progress that has been made in recent years in human genetics and cytogenetics and recognize that it now extends far beyond work on the traditional blood groups in the domain of the immunohematologist and involves such specialists as the biochemical geneticist, the cytogeneticist, and the human geneticist.[107] The laboratory procedures of modern human genetics provide an efficient, accurate method for determining nonpaternity and for obtaining reliable evidence in affirmatively proving paternity.[108] In all paternity cases, whether settled or brought to trial, compulsory tests should be a presettlement or pretrial routine. The courts should accept the evidence provided by the laboratory workers and the experts in the various fields both as to exclusions and as to the remarkable similarity between the genetic description of the father as observed in the child, and the genetic description of the putative father. If the tests show an exclusion, that should be considered conclusive and the proceeding terminated. Where the tests indicate the possibility of the putative father's paternity, experts from the testing laboratory should indicate the degree of probability of paternity based on thorough testing. The degree of probability should then be considered along with all other evidence. Scientific knowledge can thereby best be used to minimize the bitterness, emotional torment, and deceit which so often accompany paternity suits, and courts can feel assured that they are more efficiently and fairly reaching the truth.

ACKNOWLEDGEMENT

The author would like to thank William Beautyman, M.D., Chief of Pathology and Director of Laboratories at the Berkshire Medical Center, Pittsfield, Massachusetts, for his considerate and helpful suggestions.

REFERENCES

1. Y.B., 12 Edw. 2, 388 (ed. 1679 from Sergeant Maynard's MS).
2. In 1576 the Elizabethan Poor Law created the paternity suit to force fathers to support their illegitimate children. An Act for Setting the Poor on Work, 18 Eliz. I, c. 3 § 2 (1576).
3. From 1948 through 1961, the Cuyahoga County Juvenile Court of Ohio handled approximately 12,000 paternity cases. *Family Law, Proof of Paternity in Civil Proceedings,* Published Working Paper No. 12 at 41 (1967) (Harvard Law Library).

   Almost 7 percent of all live births in the United States in 1964 were illegitimate, compared with a 0.7 percent illegitimacy rate in 1940. Holz. The trial of a paternity case. 50 Marq. L. Rev. 450, 451 (1967). The illegitimacy rate reaches 40 percent in many urban areas and exceeds 50 percent in some. H. Krause, Illegitimacy: Law and Social Policy 8 (1971). Part of the increase in paternity actions may be attributed to legislation requiring fathers who desert their families to contribute to the support of their families. 42 U.S.C. §§ 602(a) (21) (1971) (AFDC Program). *See* note 56 *infra.*
4. Mich. Stat. Ann. § 722.714(f) (1968) specifically authorizes a father to bring the action.
5. Conn. Gen. Stat. Ann. § 52-440a (1960); Me. Rev. Stat. Ann. tit. 19, § 272 (Cum. Supp. 1974); Md. Code Ann. art. 16, § 66C (1966); Minn. Stat. Ann. § 257.18 (1965); N.H. Rev. Stat. Ann. §§ 168:6, 168:9 (1964); Pa. Stat. Ann. tit. 62, § 2043.35 (1968); R.I. Gen. Laws Ann. § 15-8-1 (1970); S.C. Code Ann. § 20-305 (1962); Va. Code Ann. § 20-64 (1960); Wis. Stat. Ann. § 52.25 (Supp. 1969).
6. Ky. Rev. Stat. Ann. § 406.021 (Supp. 1968); Mont. Rev. Codes Ann. § 93-2901-2 (1964); N.Y. Family Ct. Act § 522 (McKinney 1963); Pa. Stat. Ann. tit. 62, § 2043.35 (1968).
7. Ala. Code tit. 27, § 12(1) (Supp. 1969).
8. Del. Code Ann. tit. 13, § 1321 (1953); Hawaii Rev. Stat. § 579-1 (1968); Iowa Code Ann. § 675.8 (1966).
9. *E.g.*, Cortese v. Cortese, 10 N.J. Super. 152, 76 A.2d 717 (1950); Hansom v. Hansom,

75 Misc.2d 3, 346 N.Y. S.2d 966 (1973); Commonwealth *ex rel.* Goldman v. Goldman, 199 Pa. Super. 274, 184 A.2d 351 (1962).

10. *E.g.,* Ford v. Ford, 191 Neb. 548, 216 N.W.2d 176 (1974); Bednarik v. Bednarik, 18 N.J. Misc. 633, 16 A.2d 80 (1940); C. v. C., 200 Misc. 631, 109 N.Y.S.2d 276 (1951).
11. *E.g.,* Anderson v. Anderson, Circuit Court, Cook County Chicago, Ill., Gen. No. 41C-487, published in 108 N.Y.L.J. 603 (1942), but not in the Illinois official reports. *Seals v. Jacobs,* 292 So.2d 885 (La. App. 1974).
12. *E.g.,* Roe v. Roe, 65 Misc.2d 335, 316 N.Y.S.2d 94 (1970); Slawek v. Stroh, 62 Wis. 2d 295, 215 N.W.2d 9 (1974). The opinion of the latter case stated that the putative father of an illegitimate child has a constitutional right to establish, if he can, his natural parentage and to assert parental rights. 215 N.W.2d at 15.
13. *E.g.,* Roe v. Doe, 56 Misc.2d 59, 287 N.Y.S.2d 292 (1968).
14. For example, a child may wish to prove a particular paternity in order to recover under the Social Security Act [*see* Mathews v. Lucas, No. 75–88, 44 U.S.L.W. 5139 (June 29, 1976)] or the putative father's will. In re Estate of Hendrix, 68 Misc.2d 439, 326 N.Y. Supp.2d 646 (1971); In re Estate of R. Belton, 70 Misc.2d 814, 335 N.Y.S.2d 177 (1972). *See* Wiener, *Chances of Proving Non-Paternity by Blood Grouping Tests when the Putative Father is Dead,* 3 ADVANCES IN BLOOD GROUPING 300 (1970).
15. Courtroom conflicts are so acrid and punishing for all the parties that some scholars have argued for abandonment of the paternity action. *E.g.,* M. VIRTUE, FAMILY CASES IN COURT, 36–37 (1956).
16. "In many of the paternity cases reaching appellate courts it seems reasonably clear that no more than lip service, if that, has been accorded . . . with the result, we fear, that often the determination represents . . . the application of the Judge's subjective judgment. . . ." Gray v. Rose, 30 A.D.2d 138, 290 N.Y.S.2d 647 (1968). The court also expressed concern that there is not adequate judicial evaluation of the evidence, in view of the severe financial penalty involved, and that the respondent is highly vulnerable if he admits sexual relations or fails to testify.

    One study estimates that of 4,200 paternity cases arising in New York City in 1959, 645 men (more than one in seven) were erroneously held liable as "fathers" of someone else's children. Sussman, *Blood Grouping Tests—A Review of 1000 Cases of Disputed Paternity,* 40 AM. J. CLINICAL PATHOLOGY 38, 41 (1963).

    In 1969, the Family Study Commission, State of Illinois, in its Report and Recommendations to the 76th General Assembly (55-1969) wrote:

    > The investigation and information obtained by the Commission on paternity law and practice leads to the inescapable conclusion that coercion, corruption, perjury and indifference to the rights of the individual defendant pervade in the day to day practice in this area of judicial proceedings. . . . Testimony before the Commission revealed that generally defendants appear before judges who have a daily case load of about 140 cases. . . . Testimony from the sitting judiciary hearing paternity cases revealed to the Commission that the evidence in most cases consists of an accusation by the woman and a denial by the defendant. Under such circumstances, the judges feel constrained to enter a finding of paternity. Not even the slightest corroborating evidence is required. . . .

    H. KRAUSE, ILLEGITIMACY: LAW AND SOCIAL POLICY 107 (1971).
17. In a debate in the British House of Lords on a proposed bill to authorize blood tests in paternity cases, Lord Merthyr observed,

    > In my experience of these cases, apart from one other class—namely fish poaching cases—there is no class of case in which there is a greater degree of perjury in the courts. In the cases which are fought at all there is always a flat denial on the one side or the other of the facts at issue.

    229 Parl. Deb., H.L. (5th Ser.) 1090 (1961).

18. Schatkin, *Should Paternity Cases be Tried in a Civil or Criminal Court?* 1 CRIM. L. REV. (N.Y.) 18, 24 (1954).
19. Sussman, *Blood Grouping Tests—A Review of 1000 Cases of Disputed Paternity,* 40 AM. J. CLINICAL PATHOLOGY 38, 41 (1963).
20. Sussman and Schatkin, *Blood Grouping Tests in Undisputed Paternity Proceedings,* 164 J.A.M.A. 249–50 (1957). Many fathers do not admit paternity but believe they would not have a fair chance to prove nonpaternity in court. Arthur and Reid, *Utilizing the Lie Detector Technique to Determine the Truth in Disputed Paternity Cases,* 45 J. CRIM. L.C. AND P.S. 213, 215 (1954). Some experts in the field have recommended that lie detector tests be required to substantiate testimony in paternity actions. S. SCHATKIN, DISPUTED PATERNITY PROCEEDINGS 5 (Supp. 1974).
21. S. SCHATKIN, DISPUTED PATERNITY PROCEEDINGS 5–6 (Supp. 1974). The doctrine of *exceptio plurium concubentium* (that the mother of the illegitimate child had sexual relations with someone other than the defendant about the time of conception) is a defense to a bastardy proceeding. Blood test evidence would in many cases make such issues irrelevant and save the parties and the courts considerable acrimony.
22. Sussman, *supra* note 19, at 38; Glazer, *Blood Grouping Tests in the Proof of Non-Paternity,* 33 MICH. ST. B.J. No. 1, 12, 17.
23. H. KRAUSE, ILLEGITIMACY: LAW + SOCIAL POLICY 108 (1971); Krause, *Scientific Evidence and the Ascertainment of Paternity,* 5 FAMILY L.Q. 252, 255 (1971). Krause also suggests that many paternity actions are not brought simply because the mother fears the sordid spectacle those actions usually create. 5 FAMILY L.Q. at 254. Other fears are not unfounded: a judgment of $6,000 was recovered by a man wrongly charged by the Welfare Department in a paternity action. *Watson v. City of New York,* 57 Misc.2d 542, 293 N.Y.S.2d 348 (N.Y. City Ct. 1968).
24. *See* note 35 *infra* for an explanation of this test. As used in this article, "blood test" refers to all genetic tests based on blood samples, whereas "blood group test" refers only to tests used to ascertain the blood groups (*e.g.* ABO, MNS) to which an individual belongs.
25. See note 61 *infra.*
26. This is so even though five states, Kentucky, Louisiana, New Hampshire, Oregon, and Utah, have adopted § 4 of the Uniform Act on Blood Tests to Determine Paternity which states:

> If the experts conclude that the blood tests show the possibility of the alleged father's paternity, admission of this evidence is within the discretion of the court, depending upon the infrequency of the blood type.

See note 60 *infra.*

27. *See* p. 14 *infra.*
28. For a general discussion of this material, *see* E. GARDNER, PRINCIPLES OF GENETICS (4th ed. 1972); D. HARLEY, MEDICO-LEGAL BLOOD GROUP DETERMINATION (1943); R. RACE & R. SANGER, BLOOD GROUPS IN MAN (5th ed. 1968). Although this presentation is intended to demonstrate the usefulness of these procedures in paternity disputes, other medicolegal applications are feasible; for example, personal identification, the resolution of "kidnapped" babies, identification of infants when hospital nursery confusion has occurred, or identification of a suspect when blood, semen, or saliva stains can be tested.
29. The study of the inheritance of chromosomes in cells is known as cytogenetics.
30. Although a female has identical sex chromosomes, termed X chromosomes, the male has one X and one Y chromosome, the latter being much smaller than the X chromosome. If the child receives the father's Y chromosome it will be a male, and if it receives the father's X chromosome it will be a female. *See* J. THOMPSON & M. THOMPSON, GENETICS IN MEDICINE (2d ed. 1973).
31. Caspersson, Lomakka, & Zech, *The 24 Fluorescence Patterns of the Human Metaphase Chromosomes—distinguishing characters and variability,* 67 HEREDITAS 89 (1971).

32. H. Roman, L. Sandler, A. Campbell, 7 Annual Review of Genetics (9173); Borgaonkar, McKusick, Herr, de los Cobos, & Yoder. *Constancy of the Length of Human Y Chromosome,* 12 Annales de Genetique No. 4, 262 (1969); Genest, *A Human Satellited Y Chromosome with a Probable Illegitimate Paternal Origin,* 107 Can. Med. Assoc. J. 1205 (1972); Jonasson, et al., *HL-A Antigens and Heteromorphic Fluorescence Characters of Chromosomes in Prenatal Paternity Investigation,* 236 Nature 312 (1972).
33. The term polymorphism is also applied in a different sense to the variations in the appearance of chromosomes. *See* H. Roman, L. Sandler, A. Campbell, 7 Annual Review of Genetics (1973).
34. In some situations laboratory procedures determine the genotype by testing directly for the protein product of the genes. An example of this is the determination of the haptoglobin type of an individual. The haptoglobins are a species of serum protein whose structure is determined directly by the genes controlling its synthesis. On the other hand, when the phenotype is dependent on the protein that has been synthesized but is not the protein itself, tests may be made to determine the phenotype. An example of this occurs in the ABO blood group system. The ABO genes determine the synthesis of a protein which is an enzyme, and this enzyme biochemically modifies a basic blood group substance to give it the characteristics of type A, type B, type O, et cetera. When blood is ABO typed, it is this modified basic blood group substance that is detected—not the enzyme. *See* J. Thompson & M. Thompson, Genetics in Medicine (2d ed. 1973).
35. Examples of those techniques, which, contrary to popular belief, go beyond basic blood grouping, include:

    1. *Immunologic tests*: Most proteins act as antigens, provoking the formation of antibodies when injected into an animal other than the animal from which the protein was derived. The antibody, also a protein and present in the injected animal's serum, has the ability to combine with the antigen, and this combination may be detected by observing the precipitate formed when the two are mixed. Red blood cells carry on their surfaces antigens which may be detected by the agglutination (clumping) of the red cells that occurs when they are mixed with an antiserum containing the appropriate antibody. Thus, given a serum containing a known antibody, the presence of the corresponding antigen can be detected. Red blood cell characteristics, based on the various antigens detected through agglutination, have been arranged into systems, each of which contains a number of related antigens (*e.g.*, the ABO system, the MNS system, and the Rhesus system). *See* A. Wiener, Advances in Blood Grouping, 1 (1970)).
    2. *Electrophoresis:* Proteins (and this includes enzymes since all enzymes are proteins) can be made to move in an electric field. Since different proteins move with different velocities depending on the electric charge on the protein and, in some cases, depending on the size of the protein, polymorphism of proteins and enzymes can often be determined by passing an electric charge across a sample, and the results used in paternity testing. *See* E. Giblett, Genetic Markers in Human Blood (1969); O. Prokop & G. Uhlenbrock, Human Blood and Serum Groups (2d ed. 1969).
    3. *Immunoelectrophoresis:* After proteins have been separated by electrophoresis in a gel, they will react with an antibody to form characteristic zones of precipitation in the gel that may also reveal polymorphism.
    4. *Tissue typing:* All the cells of the body carry the so-called histocompatibility antigens that cause tissue grafts (*e.g.*, skin grafts) to be rejected if the recipient of the graft does not have the same antigens as are present in the donor of the graft. The major group of such antigens is known as the HL-A system (Human Leukocyte-A locus). The presence of these antigens may be detected by using the white cells of the blood and a suitable antiserum that either agglutinates the white cells or damages them so that they are stainable with suitable dyes that do not affect the damaged cells. Other components of this system may be detected by observing the

characteristic swelling reaction of lymphocytes that do not contain the antigen when they are placed in contact with lymphocytes that do contain it. [The term antigen is used loosely in this context because no antibody is thought to be involved]. *See* J. THOMPSON & M. THOMPSON, GENETICS IN MEDICINE (2d ed. 1973); Ceppellini & van Rood, The HL-A System, 11 SEMINARS IN HEMATOLOGY, No. 3, 233 (1974). Herbich, *et al., Use of the Enzyme System of Erythrocyte Phosphoglucomutase in Paternity Cases,* 81 WIEN. KLIN WASCHR 661 (1969); Reinsbou, *Disalbuminaemia as Evidence in a Case of Disputed Paternity,* 18 ACTER GENET. (BASEL) 271 (1968).

5. *Other techniques:* The presence of certain blood group substances may be detected in the saliva and other secretions of some individuals, and this also is genetically determined, as is the ability to taste the organic compound phenylthiocarbamide. Both these tests may be used in studies to establish paternity. O. PROKOP & G. UHLENBROCK, HUMAN BLOOD AND SERUM GROUPS (2d ed. 1969).

Lastly, there are some protein variants that are associated with disease and although individually most of these are rare, there are so many variants that cumulatively they are not uncommon. Most of them are recessive (i.e., the same abnormality has to be present on the appropriate gene of both chromosomes, maternal and paternal, to result in disease), but there are techniques available for detecting the presence of only one abnormal gene. These techniques may therefore be useful in attempting to establish or exclude paternity. V. MCKUCICK, MENDELIAN INHERITANCE IN MAN (3d ed. 1971).

See also, E. GIBLETT, GENETIC MARKERS IN HUMAN BLOOD (1969); Bender, et al., *Paternity Exclusion Using the Transferring System*; 140 Z. IMMUNITAETSFORSCH ALLERG. KLIN. IMMUNOL. 468 (1970); Hanihara, *The Application of Tooth Crown Characters to Paternity Tests,* 24 JAP. J. LEGAL MED. 247 (1970); Holt, *Inheritance of Dermal Ridge Patterns, Recent Advances in Human Genetics* 101 (1961) [the inheritance of dermatoglyphic traits]; Keiter, *Advances in Anthropological Testing,* 21 AM. J. PHYS. ANTHROPOLOGY—81 (1963); Kelleman et al., *Suitability of the Pi-System in Disputed Paternity,* 71 Z. RECHTSMED 34 (1972); Lefevre et al., *Value of the Adenosine Diaminase (ADA) Isoenzyme System for Forensic Evidence,* 71 Z. RECHTSMED 17 (1972); Teisberg, *Application of the C'3 System in Paternity Cases,* 22 VON SANQUINIS 213 (1972); Vesell, *Advances in Pharmacogenelics,* 11 PROGRESS IN MEDICAL GENETICS 291 (1973) [Pharmacogenetics is the study of the hereditary component of clinically significant individual variations in the disposition and effects of drugs.].

36. Sussman, *Medicolegal Blood Grouping Tests,* 5 PROGRESS IN CLINICAL PATHOLOGY 143 (1973).
37. Ceppellini & van Rood, *The HL-A System,* 11 SEMINARS IN HEMATOLOGY 233 (1974). For an explanation of the HL-A system, *see* note 35 *supra.*
38. An exception is the Le_a antigen of red cells, but the Lewis system is not used in paternity testing.
39. The ABO, MNS, and Rhesus factor systems are three of the more commonly known blood groups. *See* note 35 *supra.*
40. R. RACE & R. SANGER, BLOOD GROUPS IN MAN 360 (5th ed. 1968).
41. Jeannet, Hassig, & Burnheim, *Use of the HL-A Antigen System in Disputed Paternity Cases,* 23 VOX SANGUINIS, 197 (1972). *Cf.* Henningsen, *Some Aspects of Blood Grouping in Cases of Disputed Paternity in Denmark,* 2 METHODS OF FORENSIC SCIENCE 209, 210 (1963). For an explanation of the HL-A system *see* note 35 *supra.*
42. *See Pitfalls, infra* at p. 7.
43. The progress is exemplified by cases where paternity has been established in mid-term pregnancy by fluorescent examination of antigens and chromosome patterns in the amniotic cells. *HL-A Antigens and Heteromorphic Fluorescence Characters in Prenatal Paternity Investigation,* 236 Nature 312 (1972).
44. Gurtler, *Principles of Blood Group Statistical Evaluation of Paternity Cases,* at the University Institute of Forensic Medicine, Copenhagen (1972); Reissig, *Computation of Paternity Probabilities,* 69 Z. RECHTSMED 118 (1971); Schwerd, *Use of Probability Concepts in Blood Group Expert Evaluation,* 30 BEITRE GERICHTL MED 406 (1973).

45. Possessing identical genes at a given locus on each of two paired chromosomes.
46. Possessing two different genes at a given locus on each of two paired chromosomes.
47. Oepen & Schmidt, *In welchem Ausmar differieren Ergebnisse biostatistischer Berechnungen bei Andwendung verschiedener Verfahren?* 30 BEITR GERICHT 1 333 (1973).
48. The application of Bayes' Theorem may be explained as follows:

Assume: P.F. is the putative father
G is the gene or collection of genes the true father must have passed on to the offspring
gf is the frequency of G among men who could possibly have been the father (i.e., the homozygotes plus the heterozygotes)
gp is the frequency of G among the population at large
hG is the prior probability that a man with G is the father
hR is the prior probability that a random man in the population is the father

Then, Bayes' Theorem states:

$$\text{the probability that P.F. is the father} = \frac{\text{gf} \times \text{hG}}{(\text{gf} \times \text{hG}) + (\text{gp} \times \text{hR})} \qquad (1)$$

Since there is no reason to suppose that the true father was chosen because of his genotype, the prior probability that a man with G is the father equals the prior probability that a random man in the population is the father. So, the expression reduces to:

$$\text{The probability that P.F. is the father} = \frac{\text{gf}}{\text{gf} + \text{gp}} \qquad (2)$$

$$\text{[dividing numerator and denominator by gf]} = \frac{1}{1 + \text{gp}/\text{gf}}$$

In the Essen-Möller version of Bayes' Theorem X_1, X_2, X_3, et cetera, are used for the gene frequencies among the possible fathers and Y_1, Y_2, Y_3, et cetera, are used for the gene frequencies at large. That is, gf = X_1 multiplied by X_2, multiplied by X_3, et cetera. So the Essen-Möller formula may be stated:

$$\frac{1}{1 + \frac{Y_1}{X_1} \quad \frac{Y_2}{X_2} \quad \frac{Y_3}{X_3}}$$

It should be noted that the mathematical probability calculated with this formula depends on certain assumptions about the population from which the father is drawn. The gene frequencies, and therefore the probabilities, will change if it is known for certain that the father was of a particular ethnic group because gene frequencies vary with ethnic grouping. There is also the possible limitation that figures for the frequency of these genes in all populations may not always be available. This would not be a significant problem in the United States where figures are available even for most ethnic groups.

The formula also assumes that there is no connection between the father's genotype and the woman's choice of a partner. If it could be shown that, for example, blood group A was associated with red hair or that haptoglobin type 1 was associated with an aroma and the woman found red hair or the aroma attractive, the formula would give erroneous results since the step simplifying formula (1) to formula (2) would not be valid.

For other applications of the Bayes' Theorem, *see* Finkelstein & Fairley, *A*

Bayesian Approach to Identification Evidence, 83 Harv. L. Rev. 489 (1970); Tribe, *Trial by Mathematics: Precision and Ritual in the Legal Process,* 84 Harv. L. Rev. 1329 (1971).

49. Keiter, *supra* note 35 at 81.
50. If a rare gene is found in the putative father or in the child but not in the mother, then the analysis is simplified. The rare $\mathrm{M_g}$ of the MNS group is an example of an antigen that could practically prove paternity. R. Race & R. Sanger, Blood Groups in Man 453 (5th ed. 1968).
51. *See* Wiener, *Blood Grouping Tests in Disputed Parentage, Qualification of Experts,* 13 Acta Geneticae Medicae et Gemellologiae 340 (1964).
52. Littell & Sturgeon, *Defects in Discovery and Testing Procedures: Two Problems in the Medico-Legal Predication of Blood Grouping Tests,* 5 U.C.L.A. Rev. 629 (1958).
53. R. Race & R. Sanger, Blood Groups in Man 105, 451 (5th ed. 1968).
54. Stevenson & Kerr. *Distribution of Frequencies of Mutations to Genes,* 4 Mutation Research 339 (1967).
55. Id.; Dodd, *The Scope of Blood Grouping in the Elucidation of Problems of Paternity,* 9 Medicine, Science and the Law 56, 59 (1969).
56. The federal government may soon be aiding in the development of regional blood centers. The Senate Finance Committee has held hearings of S. Bill 2081 which would establish procedures for the tracking down of fathers who desert their children to the welfare rolls. A section of the bill calls for the ascertainment of paternity at blood testing centers to be built with federal funds at various locales throughout the country. The Bill's proponents consider the present state of medical knowledge sufficient for the positive assignment of paternity.
57. Some experts believe that the state, county, or municipality should bear the cost of serological tests. Schatkin & Levine, *Paternity Blood Tests,* reprinted from New Jersey L.J., at 10 (1939). In criminal proceedings where paternity is an issue, the state may be constitutionally required to bear the cost. Commonwealth v. Possehl, 355 Mass. 575, 246 N.E.2d 667 (1969), calling the state's burden "the necessary consequence of Griffin v. Illinois, 351 U.S. 12 (1956)."
58. Ross, *The Value of Blood Tests as Evidence in Paternity Cases,* 71 Harv. L. Rev. 460, 467 (1958).
59. For example, the Supreme Court of New Mexico recently held that a child may properly be exhibited to the jury in a paternity suit for a comparison of the similarities and dissimilarities in the physical features of the child and the putative father. Glascock v. Anderson, 83 N.M. 725, 497 P.2d 727 (1974).
    1972); Me. Rev. Stat. Ann. tit. 19 § 277 (Cumm. Supp. 1976); N.C. Gen. Stat. § 8-501 (1976). N.H. Rev. Stat. (1974).
60. Colo. Rev. Stat. 52-1-27 (Supp. 1967); Ky. Rev. Stat. 406.081, 406.091, 406.111; La. Rev. Stat. 9:397-2 (Supp. 1972); Me, Rev. Stat. Ann. tit. 19 § 277 (Cumm. Supp. 1976); N.C. Gen.stat. § 8-501 (1976). N.H. Rev. Stat. (1974). N.H. Rev. Stat. Ann. § 522.1 (1955); Ore. Rev. Stat. § 109.258 (1953); Utah Code Ann. § 36-228 (Cum. Supp. 1973).
61. Ala. Code tit. 27 § 12 (5) (Cum. Supp. 1971) Ark. Stat. § 34.705.1 (1962); Cal. Ann. Evid. Code §§ 890–897 (West 1966); Conn. Gen. Stat. Ann. § 52-184 (1960); D.C. Code § 16-2347 (1966); Ill. S.H.A. ch. 1063/4 §§ 1‡7 (1952); Dale v. Buckingham, 241 Iowa 40, 40 N.W.2d 45 (1949); Ky. Rev. Stat. 406.081, 406.091, 406.111 (1973) (Uniform Act on Paternity); Me. Rev. Stat. Ann. tit. 19 § 277 (Cum. Supp. 1974) (Uniform Act on Paternity); Md. Code art. 16 § 66G (1957); Mass. Gen. L. Ann. c. 273 § 12A (1970); Mich. Stat. Ann. § 722.716 (1968); Miss. Code Ann. § 93-9-21 (1972); Nev. Rev. Stat. 56.010 (1973); N.H. Family Ct. Act §§ 522:1-522:10 (1955); N.J. Stat. Ann. 2A;8302 (1952); N.Y. Family Ct. Act § 418, 532 (McKinney's 1962); N.C. Gen. Stat. § 8-50.1 (repl. vol. 1969); Ohio Rev. Code § 3111.16 (1976); Ore. Rev. Stat. §§ 109.250-109.262 (1971); Pa. Stat. Ann. tit. 28 §§ 307.1-307.10 (Purdon 1974); R.I. Gen. Laws § 15-8-13 (1969); State v. Damm, 64 S.D. 309, 266 N.W. 667 (1936); Tenn. Code Ann. § (Cum. Supp. 1973); Utah Code Ann. 78-25-18 to 78-25-23 (1953); Pomainville v. Bicknell, 118 Vt. 328, 109 A.2d 342 (1954); Va. Code Ann. § 8-329.1

(Cum. Supp. 1968); W. Va. Code Ann. § 8-329.1 Supp. 1973); Wis. Stat. Ann. 325.23 (1958).

62. Richardson v. Richardson, 252 Ark. 244, 478 S.W.2d 423 (1972); Wareham v. Wareham, 195 Cal. App.2d 64, 15 Cal. Rptr. 465 (1961); Kusior v. Silver, 54 Cal.2d 603, 354 P.2d 657, 7 Cal. Rptr. 129 (1960); Cal. Evid. Code § 621 (West 1966); Williams v. Williams, 230 La. 1, 87 So.2d 707 (1956); Md. Code Ann. art. 16. § 66G (1066); Rasco v. Rasco, 477 S.W.2d 10 (Mo. Ct. App. 1969); Swift v. Swift, 65 Misc.2d 1014, 319 N.Y.S.2d 655, 660 (1971); Wright v. Wright, 11 N.C. App. 190, 180 S.E.2d 369 (1971); State v. Eli, 62 N.W.2d 469 (N.D. 1954); Ohio Rev. Code § 3111.16 (1964), *but see* State *ex rel.* Steiger v. Gray, 30 O.2d 294, 145 N.E.2d 162 (1957); Ore. Rev. Stat. § 41.350(6) (1971).

63. California, Colorado, Illinois, Louisiana, New Hampshire, Oklahoma, Oregon, Pennsylvania, and Utah. Kentucky and Maine have adopted the Uniform Act on Paternity which contains similar provisions.

64. United States Canal Zone.

65. Uniform Act on Blood Tests to Determine Paternity, § 1, 9 Uniform Laws Ann. 110 (1957). If a party refuses to consent to the test, the court may either enforce its order or resolve the question of paternity against the party so refusing, but most statutes, as enacted, take the weaker position that a refusal to take the test may be disclosed at the trial and commented upon.

66. State *ex rel.* Van Camp v. Welling, 220 Ohio L. Abs. 448, 6 Ohio Ops. 371 (1945); State v. Damm, 64 S.D. 309, 266 N.W. 667 (1936).

67. Uniform Act, § 4.

68. *Id.*

69. California, Illinois, Oklahoma, and Pennsylvania. *See* note 60 *supra.*

70. P.H. Andresen, The Human Blood Groups Utilized in Disputed Paternity Cases & Criminal Proceedings. 101-4 (1952); S. Schatkin, Disputed Paternity Proceedings, 234 (4th ed. 1973). The report of the Inter-Scandinavian meeting on Genetics and Legal Medicine showed the biologic certainty of exclusions for selected blood groups as follows:

ABO System	over 99.99 percent
MNS System	over 89.99 percent
Rh System	about 99.99 percent
P System	about 99.99 percent

Ross, *The Value of Blood Tests as Evidence in Paternity Cases*, 71 Harv. L. Rev. 466, 468 (1958).

71. See note 16 and accompanying text *supra.*

72. This is true even though some statutes permit evidence of the possibility of paternity to be admitted. *See* note 60 *supra.* Some trial courts have admitted the affirmative evidence only to be reversed on appeal. *E.g.,* State *ex rel.* Freeman v. Morris, 156 Ohio St. 333, 102 N.E.2d 450 (1951).

73. L. Sussman, Blood Grouping Tests—Medico-Legal Uses 83 (1968).

74. Hummel, *Der positive Beweis der Abstammung im serologischen Gutachten; molgiche Auswirkung auf die foresiche Praxis,* 4 Schriften Des Deutschen Instituts Fur Vormundschaftswesen, Unehelichenrecht im Wandel 66 (1967).

75. *E.g.,* Fitzsimmons v. DeCicco, 44 Misc.2d 307, 253 N.Y.S.2d 603 (Fam. Ct. 1964). Note, however, that paternity may arise in criminal proceedings such as a prosecution for the crime of bastardy or fornication. *See* Mass. Gen. L. Ann. c. 273, § 11 (1970).

76. *See* note 16 and accompanying text *supra.*

77. S. Schatkin, Disputed Paternity Proceedings, 9 (Supp. 1974).

78. *Id.* at 10 (Supp. 1973).

79. *Id.* at vi (Supp. 1973).

80. Note that the chance of exclusion is at least 98.5 percent. *See* note 41 and accompanying text *supra.*
81. Miller v. Domanski, 26 N.J. Super. 316, 97 A.2d 641 (1953); Isham v. Mullaly, 15 Wis.2d 249, 112 N.W.2d 701 (1961).
82. *See* note 16 and accompanying text *supra.*
83. *See,* Hummel, *Evaluation of the Probability of Paternity As Determined by the Essen-Möller Formula in a Given Mother-Child Constellation,* 67 Z RECHTSMED 27 (1970).
84. *Id. See also* Schoch, *Determination of Paternity by Blood-Grouping Tests: The European Experience,* 16 S. CAL. L. REV. 177 (1943). Some European courts will consider all available anthropological evidence including eye color and deformities such as webbed toes. *Family Law, Proof of Paternity in Civil Proceedings,* Published Working Paper No. 12, at 4 (1967) (Harvard Law Library).
85. Robertson v. Hutchinson [1935] S.L.T. 473; Sinclair v. Rankin [1921] 2. S.L.T. 200. In both cases the statistical probability of paternity was admitted as evidence to be considered by the jury in deciding which of two men was the father.
86. Bradbrook et al., *Ag(X) and Ag(Y) Antigens in Studies of Paternity Cases in the United Kingdom,* 21 HUM. HERED 493–9, (1971). Rex-Kiss et al., *Incidence and Gene Frequency of GM(1), (2), (5) and Inv.(1) Gammaglobulin Polymorphisms and Their Utilization in Paternity Determination in Hungary,* 69 Z. RECHTSMED 79–82 (1971). In one West German case, detailed blood tests were used to establish a 99.55 percent probability of paternity. L.G. Koln, 13.10. 1961, 16 MONATSSCHRIFT FUR DEUTSCHES RECHT 309 (1962).
87. Dodd, *The Scope of Blood Grouping in the Elucidation of Problems of Paternity,* 9 MEDICINE, SCIENCE, AND THE LAW, 55, 60 (1969). In Sweden the court has power to order blood tests on not only parties to the action but also on other possible fathers and power to fine any third party who refuses to comply with the court's order. *Family Law, Proof of Paternity in Civil Proceedings,* Published Working Paper No. 12, at 29 (1967) (Harvard Law Library).
88. Section 5 of the Uniform Act on Blood Testing provides: [T]he presumption of legitimacy of a child born during wedlock is overcome if the courts find that the conclusions of all the experts . . . show that the husband is not the father of the child.
89. *See* note 62 *supra.*
90. Banbury Peerage Case, 1811 1 Sim. & St. 153, *per* Sir James Mansfield C.J.
91. Goodright v. Moss, 2 Cowp. 591, 98 Eng. Rep. 1257 (1777). *Cf.* Hargrave v. Hargrave 9 Beav. 552, 50 Eng. Rep. 457 (Rolls 1946).
92. Comment, *California's Conclusive Presumption of Legitimacy—Its Effect and Its Questionable Constitutionality,* 35 S. CAL. L. REV. 437, 467 (1962); Comment, *California's Tangled Web: Blood Tests and the Conclusive Presumption of Legitimacy,* 20 STAN. L. REV. 754, 758 (1968).
93. Oliver v. England, 48 Misc.2d 335, 264 N.Y.S.2d 999 (Family Ct. 1965); Hill v. Hill, 20 App. Div.2d 923, 249 N.Y.S.2d 751 (2d Dep't, 1964).
94. Every one of the fifty states has a statute enabling parents to legitimate their illegitimate children. H. CLARK, THE LAW OF DOMESTIC RELATIONS IN THE UNITED STATES, 158 (1968).
95. *E.g.,* Gomez v. Perez. 409 U.S. 535 (1973), Weber v. Aetna Casualty & Surety Co., 406 U.S. 164 (1972); Levey v. Louisiana, 391 U.S. 68 (1968); Glona v. American Guarantee & Liability Insurance Co., 391 U.S. 73 (1968). *Contra,* Labine v. Vincent, 401 U.S. 532 (1971).
96. Holmes v. Holmes, [1966] 1 All E.R. 356.
97. The present rules admitting blood test results into evidence only in the case of exclusions also raise an equal protection question. In effect, the courts are admitting the evidence only when it aids the male's case. It may be argued that such discrimination is permissible because the truth is the paramount interest and the discrimination exists only in that dishonest women are prejudiced and honest men wrongly accused benefitted. Nevertheless, by allowing only evidence of an exclusion the courts are

structuring a rule of evidence which can only benefit one class of litigants, the males. If this can be considered a classification based on sex, then such discrimination may require a compelling state interest because classifications based on sex may be suspect. Frontiero v. Richardson, 411 U.S. 677 (1973); Reed v. Reed, 404 U.S. 71 (1971); Sailer Inn, Inc. v. Kirby, 485 P.2D 529 (1971). [Note that only four United States Supreme Court Justices have suggested classifications based on sex are suspect. *See* Kahn v. Shevin, 416 U.S. (1974). Furthermore, where the classification is natural rather than man-made, it is even less clear that a compelling state interest is required]. In any case no state interest is compelling when the probability of paternity can be determined more accurately through blood tests than through the evidence presently considered. Since it is not sensible to disregard scientific test evidence altogether to solve the equal protection problem, the results of thorough tests should be admitted whether they show a precise probability of paternity or an exclusion.

98. An analogy may be drawn to ballistics tests, which, it may be argued, should be a constitutional prerequisite to the introduction of a gun as a murder weapon. Where the tests are easily performed and the results so critical, fundamental fairness would seem to require the tests. *See* Moore v. Illinois, 408 U.S. 786, 801, fn. 1 (1971).

99. Uniform Act, § 1.

100. *E.g.*, MASS. GEN. LAWS ch. 273, § 12A (1970).

101. It is common for plaintiffs, such as husbands in divorce actions based on adultery and mothers bringing paternity actions, to refuse to submit to blood tests.

102. Note that Federal Rule of Civil Procedure 35 was amended, effective July 1, 1970, to specifically provide for court order of a physical examination to determine blood groups.

103. Davis v. State, 189 Md. 640, 57 A.2d 289 (1948); State v. Alexander, 7 N.J. 585, 83 A.2d 441 (1951); Cortese v. Cortese, 10 N.J. Super. 152, 76 A.2d 717 (App. Div. 1950); Commonwealth v. Statti, 166 Pa. Super. 577, 73 A.2d 688 (1950). The privilege against self-incrimination, more appropriate in a criminal trial, may be relevant in paternity suits where adultery will be an attendant result in a jurisdiction where adultery is a violation of the law.

104. Malloy v. Hogan, 378 U.S. 1 (1964) held that the privilege against self-incrimination in the Fifth Amendment applies to the states through the Fourteenth Amendment, and Schmerber v. California, 384 U.S. 757 (1966) held that the Fifth Amendment privilege was not violated by an involuntary blood test, and that the involuntary taking of blood was not an unlawful search and seizure under the Fourteenth Amendment.

105. United States *ex rel.* Dong Witt Ott v. Shaughnessy, 166 F. Supp. 745 (S.D. N.Y. 1953); State v. Alexander, 7 N.J. 585, 83 A.2d 441 (1951).

106. State v. Alexander, 7 N.J. 585, 83 A.2d 441 (1951). In Great Britain any judge of the High Court may order a blood test. *In re* L. [1967] 3 W.L.R. 1945, P.119 (C.A.); B. v. B. [1968] P.466, 2 All E.R. 1023 (C.A.).

107. Through joint action by the American Medical Association and the American Bar Association, the availability on a regional and national basis of appropriate laboratory facilities and consultants should be advertised to the legal profession. The testing may be carried as far as desired, but it should be recognized that the more procedures that are carried out that do not provide an exclusion, the greater the probability that the putative father is the true father. The available consultants should consist, at a minimum, of an immunohematologist (for the traditional blood group techniques), a biochemical geneticist (for the protein and enzyme analysis), and a cytogeneticist (for chromosome studies). Other consultants including physicians interested in clinical aspects of human genetics or an anthropologist may be required from time to time.

108. *Cf.* H. CLARK, THE LAW OF DOMESTIC RELATIONS IN THE UNITED STATES 171 (1968).